EN

Discussion Paper

Water and Nutrition

Harmonizing Actions for the United Nations Decade of Action on Nutrition and the United Nations Water Action Decade

UNSCN
United Nations System Standing Committee on Nutrition

February 2020

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Abstract

Progress for both SDG 2 and SDG 6 has been unsatisfactory, with several indicators worsening over time, including an increase in the number of undernourished, overweight and obese people, as well as rapid increases in the number of people at risk of severe water shortages. This lack of progress is exacerbated by climate change and growing regional and global inequities in food and water security, including access to good quality diets, leading to increased violation of the human rights to water and food.

Reversing these trends will require a much greater effort on the part of water, food security, and nutrition communities, including stronger performances by the United Nations Decade of Action on Nutrition and the United Nations International Decade for Action on Water for Sustainable Development. To date, increased collaboration by these two landmark initiatives is lacking, as neither work program has systematically explored linkages or possibilities for joint interventions.

Collaboration is especially imperative given the fundamental challenges that characterize the promotion of one priority over another. Without coordination across the water, food security, and nutrition communities, actions toward achieving SDG2 on zero hunger may contribute to further degradation of the world's water resources and as such, further derail achievement of the UN Decade of Action on Water and SDG 6 on water and sanitation. Conversely, actions to enhance SDG 6 may well reduce progress on the UN Decade of Action on Nutrition and SDG 2.

This paper reviews these challenges as part of a broader analysis of the complex web of pathways that link water, food security and nutrition outcomes. Climate change and the growing demand for water resources are also considered, given their central role in shaping future water and nutrition security. The main conclusions are presented as three recommendations focused on potential avenues to deal with the complexity of the water-nutrition nexus, and to optimize outcomes, as follows:

- Implement nutrition-sensitive agricultural water management. Nutrition and health experts need to join forces with water managers at the farm household level, at the community level and at the government level to strengthen positive transmission pathways between both rainfed and irrigated agriculture, and food and nutrition security.
- Increase the environmental sustainability of diets. More work is urgently needed on the impact of current dietary trends on environmental resources, and vice-versa. Not only in terms of documenting harm done under the current status-quo, but also with respect to practical recommendations for regional and national stakeholders on policy reform and investments that counter-act the heavy environmental and health tolls that are being exacted by current diet trends.
- Explicitly address social inequities in water-nutrition linkages. Proactively include vulnerable demographics in the development of water services, including incorporating their needs and constraints into initial infrastructure design.

The analysis and recommendations in this report are geared toward both United Nations actors and other stakeholders with access to entry points to accelerate progress. Expanding collaboration and evidence generation is particularly important outside the WASH sector where some linkages have already been developed. This will be imperative for reducing trade-offs, and for strengthening momentum.

1 Introduction

Stable access to water of sufficient quality is closely linked to food security and good nutrition (FSN), but water resources are under severe threat due to depletion and degradation as well as destruction of habitats (MA, 2005; IPBES, 2019). Paradoxically, some of these threats to water and its related ecosystems stem directly from growing demand for food, including changes in dietary patterns. Similarly, food insecurity and hunger are heightened in regions with insufficient water access or growing water degradation. Five fundamental factors or linkages affirm the strength of association between water and FSN:

- Quality and availability of water are paramount for drinking water, cooking, sanitation, and personal hygiene. These uses are typically bundled together as **WASH** (Water Supply, Sanitation and Hygiene).
- **Agriculture** is by far the largest user of freshwater withdrawals, at an estimated 70 percent, almost entirely used for irrigation.
- Water is necessary for all "activities, processes and outcomes" (cf. Ericksen et al., 2010, p. 26) related to the **food system**. This includes food production (fisheries and aquaculture, and crops and livestock), food processing (industrial to household level), and food preparation.
- Water is integral to the function and productivity of **ecosystems**.
- Water is also needed for commerce and **industry**.[1]

These linkages are highly complex. Some are bidirectional while others track only from water to FSN. None are mutually exclusive, and all of them are characterized by a fundamental tension between the two priorities. For example, narrowly promoting WASH for nutrition, without considering how such policy recommendations affect water availability in terms of primary production and subsequent food security, could lead to sub-optimal progress across a range of nutrition and water outcomes.

The United Nations (UN) 2030 Agenda for Sustainable Development (2030 Agenda) provides the most formal recognition to date of the interwoven water and FSN challenges that must be overcome to realize a better world for all (UN, 2015). In tandem with the Sustainable Development Goals (SDGs), the UN General Assembly designated 2016-2025 the UN Decade of Action on Nutrition (UN, 2016), and 2018-2028 the UN International Decade for Action on Water for Sustainable Development (UN, 2017) (see Annex A on key provisions of the two UN Decades). These two Decades and the SDGs they support[2] are predicated on the human rights to adequate food and drinking water and sanitation (UNGA, 2010; UNSCN 2010).[3]

Despite these global declarations and subsequent efforts, many countries are off-track to achieve key nutrition and water targets by 2025 or 2030. With respect to nutrition, the 2019 SDG Progress Report of the United Nations Economic and Social Council (UN ECOSOC) states:

1 Cultural, religious and recreational water uses are also important but are not further studied here.

2 SDG 2 (End hunger, achieve food security and improved nutrition and promote sustainable agriculture), and SDG 6 (Ensure availability and sustainable management of water and sanitation for all).

3 However, the use of water for food production or other productive activities is not (yet) considered a human right (see, for example, Van Koppen et al., 2017; Mehta et al. 2019).

"Hunger is on the rise again globally and undernutrition continues to affect millions of children. Public investment in agriculture globally is declining, small-scale food producers and family farmers require much greater support and increased investment in infrastructure, and technology for sustainable agriculture is urgently needed" (UN ECOSOC, 2019, p.6).

With respect to water, the report concludes: "Despite progress, billions of people still lack safe water, sanitation and handwashing facilities. Data suggest that achieving universal access to even basic sanitation service by 2030 would require a doubling in the current annual rate of progress. More efficient use and management of water are critical to address growing demand for water, threats to water security, and increasing frequency and severity of droughts and floods resulting from climate change. As of today, most countries are unlikely to reach full implementation of integrated water resources management by 2030" (UN ECOSOC, 2019, p.10).

The Voluntary Guidelines to support the progressive realization of the right to adequate food in the context of national food security refer to water in guideline 8.11: "Bearing in mind that access to water in sufficient quantity and quality for all is fundamental for life and health, States should strive to improve access to, and promote sustainable use of, water resources and their allocation among users giving due regard to efficiency and the satisfaction of basic human needs in an equitable manner and that balances the requirement of preserving or restoring the functioning of ecosystems with domestic, industrial and agricultural needs, including safeguarding drinking-water quality" (FAO, 2005).

Against this background, the fact that both the Nutrition Decade and the Water Decade were developed independently and without leveraging the other takes on new urgency. To date, neither work program has adequately explored normative linkages and joint interventions (UN Decade of Action on Nutrition Secretariat, 2019; UN, 2017).[4] As a result, both initiatives are missing a critical opportunity to identify synergies, reduce trade-offs between the two priorities, and bring countries closer to meeting both sets of targets (as well as many other SDGs).

In July 2018, a UNSCN expert group meeting on nutrition and its connections with other SDGs[5] identified the need to increase collaboration between nutrition and water experts. Publication of a comprehensive background note (Ringler et al., 2018) on the linkages between SDG 6 and the FSN component of SDG 2 increased the momentum, raising awareness of the need to consider the full set of linkages between water and nutrition, and noting that neither Decade will achieve its full potential without clarifying these linkages and addressing trade-offs.

Box 1.
Knowledge gaps facing the water-nutrition nexus

- Implement nutrition-sensitive agricultural water management.
- Lack of knowledge regarding the impact of agricultural water use on nutrition, and vice-versa.
- Lack of knowledge regarding the nutritional impact of increased volatility in water supply (too little *and* too much).
- Lack of knowledge regarding the nutritional impact of increasing competition for water between different users and across geographic boundaries.
- Lack of knowledge regarding women's and men's roles in achieving water and nutrition objectives.

Source: Adapted from Ringler et al. 2018

4 Although the Nutrition Decade's work program cites the critical role played by WASH in assuring good nutrition, additional, and equally important, linkages are not acknowledged. Increased consultation with the water community is required to address this omission.

5 Namely, SDGs 1, 6, 7, 9, 11 and 12.

This UNSCN Discussion Paper builds on the findings of these earlier initiatives. Informed by the knowledge gaps identified by Ringler et al. (Box 1), it explores the complex linkages between water and nutrition and recommends three potential avenues to deal with the complexity and optimize outcomes across the two priorities.

The paper comprises 1) a summary of trends in water insecurity and malnutrition, 2) an overview of the multiple pathways between water and nutrition, 3) a section identifying challenges related to growing competition for water, through the lenses of climate change and equity in access, and 4) a section proposing three recommendations to accelerate collaboration and joint action across the water and nutrition communities. Notably, these recommendations can be incorporated into the mid-term reviews of the two UN Decades but will also require action by actors extending beyond the UN to adequately accelerate progress. As such, this paper is also intended to provide new insights on the Water-Nutrition nexus in a way that is relevant to a wider range of organizations and their various missions and entry points for collaboration and coordination.

2 Water insecurity and malnutrition: Status and trends

2.1. Water insecurity

As the global population, urbanization and living standards increase, demand for water is growing in agriculture, industry, and for domestic use (e.g. drinking, bathing, and cooking). This growth in demand exacerbates pre-existing water stress in many regions, which is due, in part, to inadequate progress in improving efficiency of water use, and chronic underinvestment across a range of systems. For example, large-scale irrigation systems often cannot provide water to farmers when they need it, water storage systems may be leaky, and many municipal supply and sewage treatment networks are poorly maintained and unreliable and rentseeking is pervasive (for example, Repetto 1986). Additionally, approximately 80 percent of wastewater flows untreated into the environment, while non-point sources of pollution are also growing, threatening both public health and the environment, leading to costly pollution impacts, and reducing the availability of water resources for other uses (Mateo-Sagasta et al., 2018; WWAP, 2017; Rosegrant et al., 2009).

As a result, over 2 billion people currently experience sustained and extreme water insecurity. For example, a recent progress report on SDG 6 suggests that progress on achieving water and sanitation targets (see Annex B, Table B2 for full list of targets) has been unsatisfactory and uneven (UN, 2018), with 2.2 billion people lacking access to safely managed drinking-water in 2015, and 4.2 billion people lacking access to safely managed sanitation services (UN, 2018).

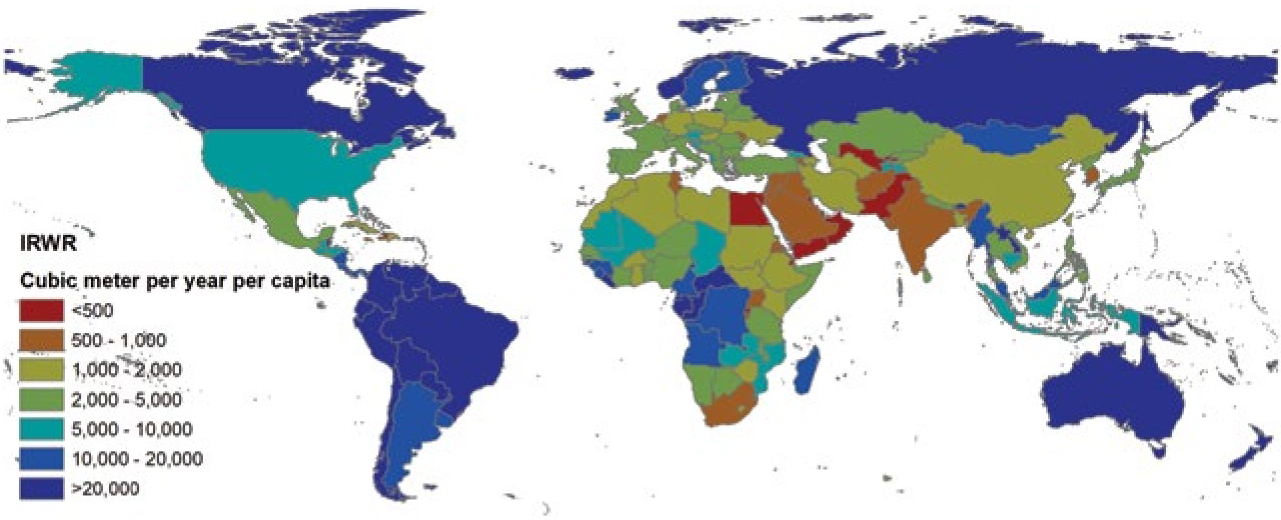
Progress on the protection and restoration of water-related ecosystems - vital to societal well-being and economic growth - has also been inadequate, with an estimated 70 percent of natural wetlands having been lost over the last century (UN, 2018).

Growing demand for water resources is exacerbated by fundamental challenges in supply. Namely, 1) over half of annual precipitation is not available for potential human use, 2) freshwater resources are unevenly distributed across regions, and uncertainty in distribution is growing with climate change, and 3) key developing regions experience high inter- and intra-annual variability of water supply (i.e. seasonality). These challenges pose a "baseline" constraint to water security in many regions. For example, annual per capita freshwater resources are particularly scarce in the Middle East, North Africa and South Asia, intra-annual variability of water supply is high in Sub-Saharan Africa, and abundance or over-abundance is high in regions with a regular monsoon season, such as South and Southeast Asia (Figure 1).

The effects of water insecurity are projected to worsen and expand as the effects of climate change intensify (UN, 2018; Ringler et al., 2016); and they will not be limited to "traditionally scarce regions".

For example, during the 2018 European heat wave, northern Europe, including Sweden, recorded record temperatures affecting people, food production and the environment. As a result, the Swedish government has budgeted close to US$130 million for drought-stricken farmers, especially to offset the mass slaughter of livestock and more expensive livestock feed as local resources were scorched; and as of October-2019, Swedish groundwater reserves in the major aquifers had not recovered to pre-2018 levels (Jan Lundqvist, personal communication).

Figure 1.
Per capita water availability, 2015



Note: Calculated as population divided by internal renewable water resources.
Source: IFPRI IMPACT (2019).

2.2. Malnutrition

In 2018, 22 percent of children (149 million) below the age of five were stunted and nearly 50 million were wasted (UNICEF, WHO, and World Bank, 2018). In 2016, 131 million children five to nine years old, and 207 million adolescents, were overweight (FAO, IFAD, UNICEF, WFP and WHO, 2019).

For adult populations, overweight and obesity have been rising every year since 2000, with rural areas currently experiencing the most rapid rate of increase (NCD Risk Factor Collaboration, 2019). In 2016, obesity affected approximately 13 percent of the global adult population, with women having a higher prevalence than men (15 percent and 11 percent, respectively) (WHO, 2018a).

Progress in addressing underweight and micronutrient deficiencies - especially anaemia among women - has also been extremely slow (FAO, IFAD, UNICEF, WFP and WHO, 2019; GNR, 2018). Currently, approximately 2 billion people face micronutrient deficiencies (GNR, 2018).

For both children and adults, different forms of malnutrition continue to compound one another. Of the 141 countries with consistent data on childhood stunting, anaemia in women of reproductive age, and overweight, 88 percent (124 countries), are experiencing high" levels[6] of at least two of these forms of malnutrition and 29 percent (41 countries) are experiencing high levels of all three (GNR, 2018).

Globally, these statistics mean that neither the 2025 World Health Assembly nutrition targets, nor the 2030 SDG nutrition targets, will be met should current trends continue. Moreover, it is important to note that these country-level data mask major inequities in gender, across countries and regions, and sub-nationally. With respect to the latter, rural areas tend to have a higher prevalence of undernutrition and – as stated above – are now also experiencing the most rapid rise in prevalence of overweight and obesity.

For individuals, these statistics mean increased risk of compromised cognitive function and compromised linear growth in childhood, lowered academic achievement in adolescence, reduced professional performance in adulthood, and increased susceptibility to both infectious disease and non-communicable diseases (NCDs) across the lifespan. These poor health outcomes and productivity shortfalls contribute to an intergenerational cycle of poverty and malnutrition which reduce long-term economic security at household level and "trickle up" to national economies, resulting in major economic losses to countries and regions. For example, the cost of undernutrition was estimated at $1-2 trillion per year, about 2-3 percent of global GDP, in 2013 (FAO, 2013); in 2016, the global economic costs of overweight and obesity were estimated at $500 billion per year (GLOPAN, 2016a).

Food insecurity is a fundamental cause of all forms of malnutrition and associated costs. And it is rising. In 2018, an estimated 822 million people were undernourished, up from about 797 million in 2016, chiefly as a result of civil conflict and strife, slow economic growth and climate variability and change (FAO, IFAD, UNICEF, WFP and WHO, 2019). Poor quality diets, which may be adequate in terms of total energy supply, but which are deficient in nutrients and too high in fats, sugars, sodium and additives, are also proliferating. Poor diet is now the number one risk factor worldwide for deaths and disability-adjusted life-years lost, and a crucial common denominator across all forms of malnutrition (Global Burden of Disease Study, 2013).

6 According to the WHO's classification of prevalence ranges. See: https://www.who.int/nutgrowthdb/about/introduction/en/index5.html.

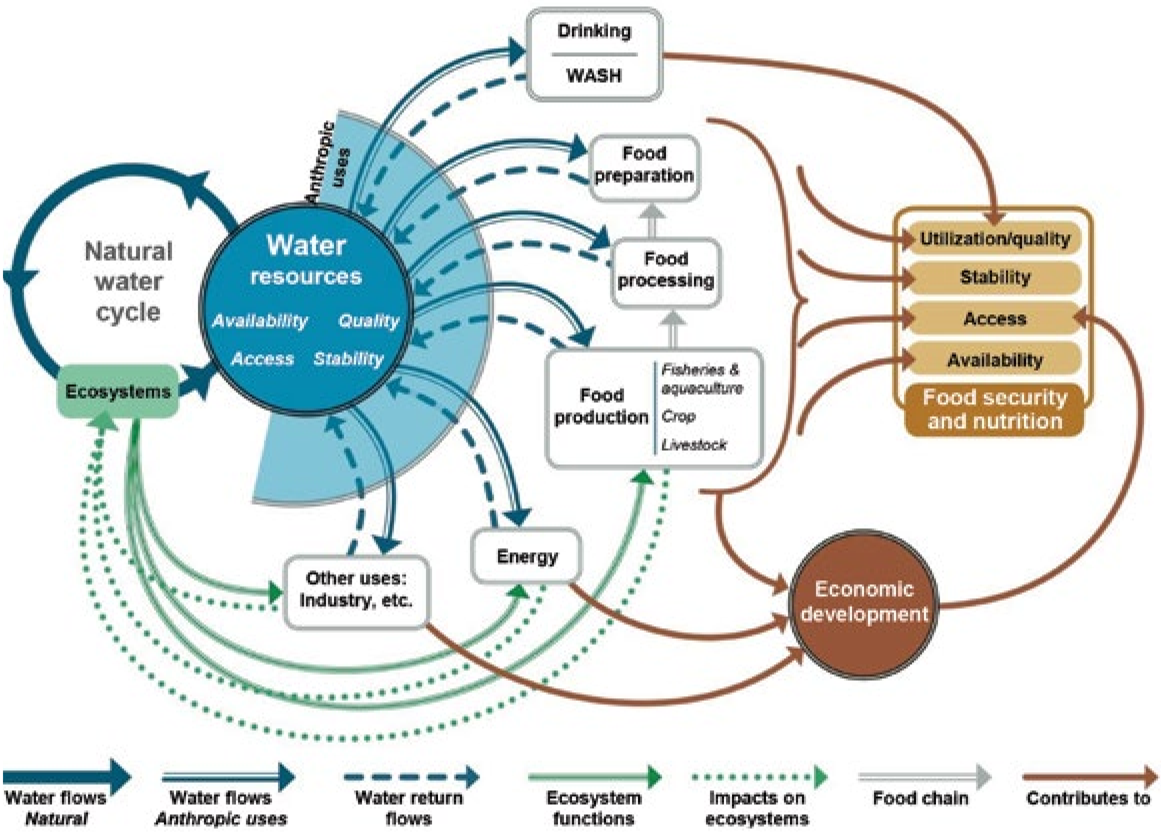
3 Linkages between water and nutrition

3.1. Overview

The four dimensions of water security – availability, access, stability, and quality – are closely linked to equivalent dimensions of FSN via pathways which span multiple sectors and entry points. These pathways are complex. Some are bidirectional while others track only from water to FSN. And none are mutually exclusive.

The fundamental linkages are summarized in Figure 2, with more detail provided on each pathway in the sections below.

Figure 2.
The linkages between water and food security and nutrition



Source: HLPE, 2015.

3.2. WASH

Adequate availability of sufficient quality of water is paramount for drinking water, cooking, sanitation, and personal hygiene. These uses are typically bundled together as **WASH** (water supply, sanitation, and hygiene), and impact human health through various pathways, including changes in time availability of mothers for caring, improved availability of safe drinking water, and improved utilization of food through changes in individuals' capacity to metabolize nutrients and fight off infection. In addition to hydration required for life itself, potable water provides nutrients and minerals such as fluoride, calcium and magnesium. These substances are important for good health, but only in the correct quantities. In regions where drinking water contains excess or insufficient amounts of these substances, side effects may offset benefits. Excess fluoride, for example, leads to fluorosis, which can permanently damage bones and joints (Wenhold and Faber, 2009). Water contaminated with pathogens such as E. coli or cholera can lead to diarrhoea and environmental enteric dysfunction. Diarrhoea is the third-leading cause of deaths across all age groups, after acute respiratory infections and malaria for children, and lower respiratory infections and HIV/AIDS for adults (WHO, 2018b). Moreover, ingestion of water contaminated with toxins such as arsenic and lead is associated with a range of negative health effects such as skin, lung, kidney, bladder and liver cancer, high blood pressure, miscarriage, and compromised cognitive and motor function (WHO, 2019).

While the highest prevalence of contaminated drinking water is in low and middle-income countries (LMICs), this problem is increasing in higher-income countries such as the United States, primarily in underserved populations where drinking water systems have been neglected for decades and in areas where self-supply is prevalent (EWG, 2019; Pierce and Jimenez, 2015).

Even when direct ingestion does not occur, lack of access to safe and clean water in or near the household is closely associated with increased infection and subsequent poor nutrition and health outcomes. Examples include use of contaminated water for cleaning and exposure to waterborne diseases, such as schistosomiasis via skin-contact. Finally, there are diseases, such as malaria carried by mosquitoes that use water as a habitat (HLPE, 2015).

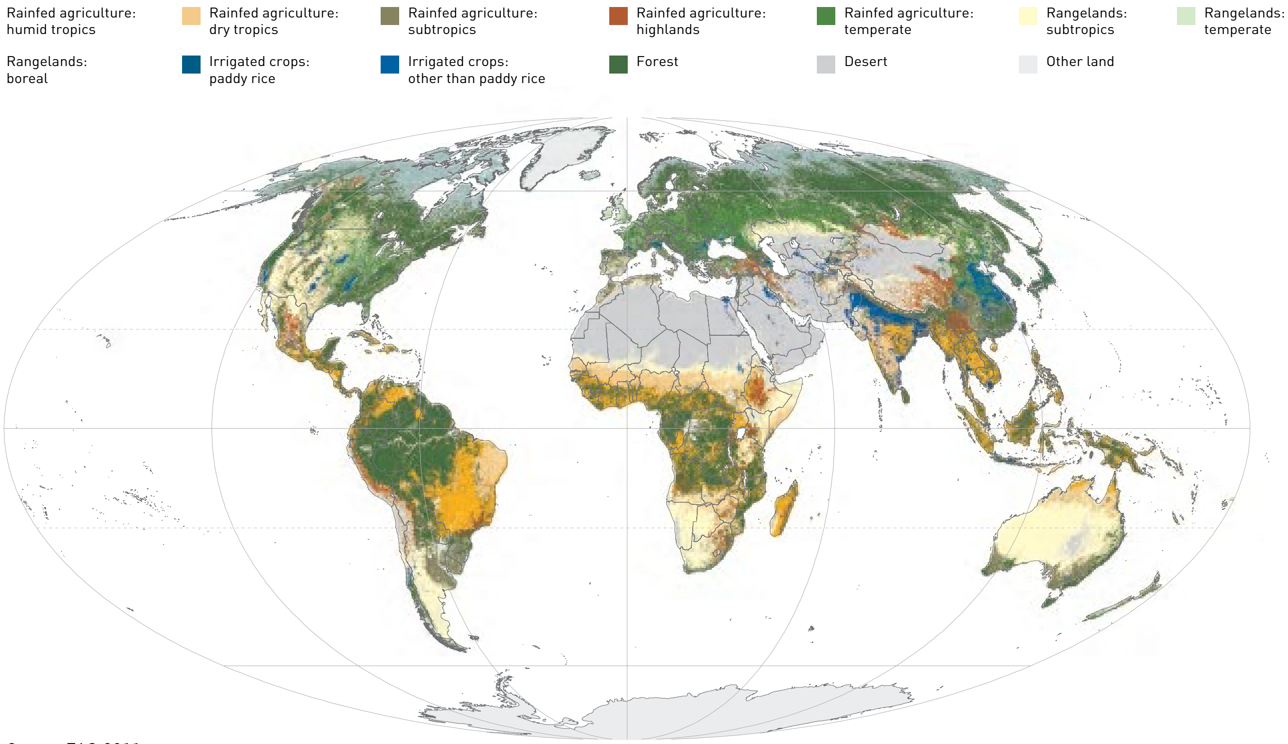
Insufficient quantity and quality of water can also affect food preparation in the household, or in restaurants or factory kitchens, as well as in food processing plants where food safety standards do not exist or are not upheld. Poor treatment of domestic and factory wastewater also affects WASH and other water uses located downstream in the same watershed, in addition to the environment.

3.3. Agriculture

Agriculture is by far the largest user of withdrawn freshwater resources, with an estimated 70 percent of withdrawals used for irrigation (FAO, 2011c). Irrigated agriculture however, accounts for less than a quarter of all water used for crop production globally (less than 1,500 km^3 out of an estimated total crop water consumption of 6,400 km3 in 2000). The remaining crops are rainfed, relying directly on soil moisture from precipitation (FAO, 2011a; Sulser et al., 2009; also see Figure 3). As such, rainfed agriculture is the primary source of food production globally. Almost all land in sub-Saharan Africa (93 percent), three-quarters of cropland in Latin America, two-thirds of cropland in the Middle East and North Africa region, and more than half of cropland in Asia is rainfed (HLPE, 2015). Rainfed agriculture is especially imperative for smallholders in the Global South.
Farmers apply water to crops to stabilize and raise yields and to increase the number of crops grown per year. Globally, irrigated yields are two to three times greater than rainfed yields. Although globally only about 20 percent of arable land is irrigated it produces about 40 percent of total crop production. And while the Green Revolution heavily relied on irrigation, it has helped avert major famines and the starvation of millions of people and has also decreased the net food import dependency in the Global South.

However, water productivity in irrigation varies considerably across systems and governance and management of irrigation systems could be strengthened in many places. As a result, many systems cannot supply water during prolonged droughts, are unable to resist floods, are high emitters of greenhouse gases and major sources of agrochemical water pollution. Consequently, in some countries irrigation systems are considered one of the main causes of degradation of freshwater ecosystems and fisheries (FAO, 2011c).

Figure 3.
Major agricultural production systems



Source: FAO 2011a.

Regardless of whether they are irrigated or rainfed, agricultural production systems affect FSN in three fundamental ways: i) production-for-own consumption, ii) income and price effects, and iii) as an entry-point for enhancing women's empowerment and improving nutrition knowledge and norms (see, for example, World Bank, 2007a; Herforth et al., 2012; Meeker and Haddad, 2013; Webb, 2013; Ruel and Alderman, 2013; Herforth and Harris, 2014; Carletto et al., 2015; FAO, 2016).

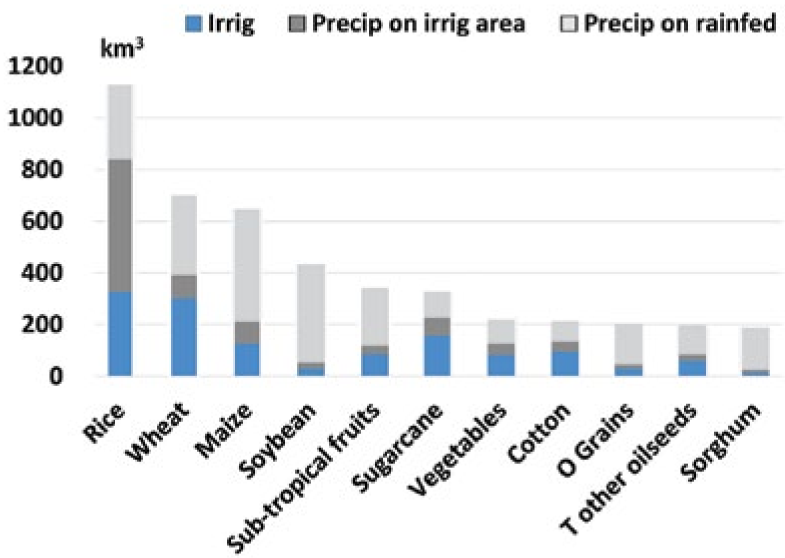
While the production-for-own consumption pathway applies exclusively to food crops, the income and women's empowerment pathway also operate for non-food crops. As such, the linkages between water and nutrition encompass not only irrigated and rainfed crops, but also food crops (which are also a part of food systems, see 2.2) and non-food crops, such as textiles and bioenergy crops.

Figure 4 shows the top ten food crops and crop groups receiving agricultural water. The top rainfed crops are wheat, maize, and soybean, while the top irrigated crops are rice, wheat and sugarcane (Ringler and Zhu 2015). Seventy to seventy-five percent of the third rainfed crop – soybean – is used as feed for livestock, poultry and aquaculture, and 19 percent is used to make vegetable oil; only the remainder (6 percent) goes directly into food products for human consumption (UCS, 2015). While these first two uses of soy are not inherently negative, animal source food and fat consumption is excessive in a growing number of countries.

In terms of water, intensive cultivation of these crops in many parts of the world has led to soil degradation, deforestation, toxic run-off and other adverse effects that decrease access to sufficient water of adequate quality.

In terms of nutrition, use of rainfall and irrigation for key crops is reflective of associated trends in undernutrition, micronutrient deficiencies and overweight/obesity described in Chapter 1, and sheds light on why the food system is not delivering healthy diets to a majority of the global population (see 3.6, below).

Figure 4.
Irrigation and precipitation water use for crop production globally for ten key crops, 2010



Irrig = irrigation water use
Precip = precipitation
Irrig area = irrigated areas
Rainfed = rainfed areas

Crops:
O Grains = Barely, Oat and Rye;
T other oilseeds = Total other oilseed crops

Source: Ringler and Zhu, 2015.

3.4. Ecosystems

Water and its related ecosystems underpin all agricultural production (CGIAR WLE, 2014), providing a range of provisioning, regulating, supporting and cultural ecosystem services, many of which, in turn, support nutrition and health outcomes by providing water for food and livestock production and fisheries. These ecosystems are under severe threat from the depletion, degradation and destruction of biodiversity and habitats (MA, 2005; IPBES, 2019), ultimately compromising the food security and nutritional status of the growing global population.

While not immediately obvious, this pathway is important, first with respect to safeguarding against health and sanitation risks introduced by agricultural production and food processing - zoonoses, standing water, agrochemicals - and second in terms of practices which protect/threaten natural resources – particularly water (Herforth and Ballard, 2016).

For example, runoff of agricultural pollution and environmentally detrimental food processing practices have created serious water-quality problems in many parts of the world, contributing to the progressive deterioration of water basins. Currently, a third of all rivers in Africa, Asia and Latin America carry heavy pathogen loads which are partially attributable to poor agricultural practices (UNEP, 2016). Deterioration of these basins directly and indirectly relates to FSN, as populations living in close contact with these rivers use them for WASH, irrigation of riparian crops, stock watering, and collection of wild foods and medicinal plants (O'Brien et al., 2018).

3.5. Industrial productivity

Water is also integral to the **function and productivity of industries** and society at large. And industries are critical to the access dimension of FSN, as they increase purchasing power. When properly regulated, industries are also major contributors to national economic growth and development.

Perhaps the most important example of the industry-based link between water security and FSN is electricity, particularly hydropower but also thermal cooling and coal mining (WWAP, 2014). A strong body of research shows that electricity provides substantial benefits in terms of socioeconomic development and resilience and also nutrition, as it expands individual's options in terms of time management and improves the capacity of institutions including hospitals and supermarkets, allowing for cold storage of nutrient-dense perishables, such as fresh milk or vegetables. In terms of FSN, access to electricity (relative to other industries), is unique in that its benefits extend to improved knowledge of nutrition and health (i.e. utilization), primarily because it permits flexibility in time management, both for children who are able to study after dark when they have electricity, and for women who can take better care of themselves and their children when they can function after nightfall and before dawn. For example, Amare et al. (2018) find that in Nigeria, night-time light intensity was a significant predictor of child nutritional outcomes, with increased electricity indicating improved nutrition outcomes, even after controlling for observable covariates known to influence child nutrition.

The focus on renewable energy has grown substantially under the Paris Climate Agreement, and hydroelectricity is the largest renewable source of energy in the world, accounting for more than three-quarters of all renewable production. As such, it holds great promise as a positive transmission pathway for the industry-based link between water security and FSN. However, it is important to note that hydropower production – which uses

reservoirs or dams – can constrain water availability for irrigation (Zeng et al. 2017), as well as undermining fisheries and ecosystems.

This example shows how competition for resources can create tensions between FSN and water security, and the subsequent need to find synergies between the two priorities. Biofuel, another low-carbon technology that has achieved prominence in climate-mitigation assessments (for example, Rogelj et al., 2018), is a second example. Cultivation of biofuel crops requires large amounts of land and water and as such competes directly with FSN in many parts of the world, particularly if rolled out to the extent envisioned in some mitigation assessments. Trade-offs are further discussed in Chapter 4, below.

3.6. The Food System

Water is necessary for all the "activities, processes and outcomes" (cf. Ericksen et al., 2010, p. 26) related to the **food system**. Namely: i) food production (fisheries and aquaculture, and crops and livestock), ii) food processing (industrial to household level), and iii) food preparation (at household level as well as by formal and informal food vendors) (HLPE, 2017). These food system components impact human health through all four FSN pathways: food availability, food access, stability of the food supply, and utilization. Nutritional and positive health outcomes of food systems are linked to the realisation of the right to adequate food. In order to diminish the negative impact of several aspects of the food system, there is the need to develop sustainable global consumption and production systems that operate through a human rights-based approach to tackle these issues.

With respect to utilization, long and medium-term food system trends, such as shifts in consumer demand linked to urbanization, increased disposable income, and changing lifestyles and marketing, underpinned by long-term trends in agricultural research and investment, trade liberalization, vertical integration of food production and supply chains, and related innovations in technology and processing have resulted in increased consumption of ultra-processed foods, animal source foods, and foods and beverages that are high in sugar, and horticultural products by wealthier populations (Lartey et al. 2018); all of these rely on crops with water needs that are higher than traditional diets or benefit from/depend on irrigation (Ringler and Zhu, 2015). While some of these foods are high in macro and micronutrients, many others, especially ultra-processed products, are associated with low fibre and protein, and high saturated fat, free sugars, sodium, and energy density (Monteiro et al., 2013). Approximately 3 billion people on the planet - close to half the world's population - currently eat low-quality diets (GLOPAN, 2016b) low in nutrient dense foods. For example, Mason D'Croz et al. (2019) find that in 2015, only 40 countries – 36 percent of the global population – had access to the WHO's age-specific recommendations for daily fruit and vegetable intake (330–600 grams).

With respect to the interaction between water security and more "macro" dimensions of FSN (availability, access, and stability), food system pathways are bidirectional. As mentioned above, the same trends that are negatively affecting diets are also affecting what is grown, galvanizing a global shift away from crops which historically comprised plant-based diets, and towards increased animal source foods, sugar, and fats and oils. This shift in cultivation priorities is exacerbating water insecurity *and* decreasing food security at population level, especially in LMICs (see 3.3, above).

4 Competition for water resources

Ensuring good nutrition under increased competition for water resources is challenging as real trade-offs need to be made in water-scarce communities and countries—such as should water be used to irrigate crops, or to maintain a sanitary environment around the household, or to produce bricks or secure other livelihoods that are water-intensive? If short-term, productive and reproductive water needs of households are given priority in water-scarce environments, then environmental water needs and associated aquatic ecosystems might degrade or even collapse. These effects threaten the sustainability of water and natural resource use, which in turn can adversely affect the livelihoods of farm households of entire nations (for example, Small et al. 2001). If water resources dried up, for example, as a result of groundwater extraction at rates exceeding the level of recharge, then eventually industries will move away, communities will suffer, and desertification can set in. Similarly, if wetlands are drained for urban or industrial development, then inland fisheries and aquatic pans will degrade and disappear, reducing access to healthy diets of communities depending on these resources (Rosegrant and Ringler, 2000; Mehta et al., 2019; Waltham et al., 2019).

The sections below unpack these issues through the lenses of i) climate change and ii) equity concerns regarding access. While reference to the previously described pathways between water security and FSN is not systematic in this chapter, is important to note that these links play out repeatedly in all the scenarios described below.

4.1. Growing competition for water: Impact of climate-change

Food production systems face some of the worst impacts from climate shocks and variability, and production systems in the Global South--where temperatures are often already high, intra-annual and inter-annual variability of water is considerable, and water control infrastructure is limited - are particularly affected.

However, impacts of climate change on food production are also substantial in the Global North. For example, climate-change related droughts have adversely affected large swathes of the American mid-west and California, as well as Europe and Australia, temporarily increasing the cost of livestock feed, horticulture, meat, and dairy (for example, Bush and Lemmen, 2019; USGRCP, 2018; EEA, 2019).

To address these crises and to minimize the trade-off as mentioned above, it is imperative to look at these challenges with a rights based-lens. Human rights are indivisible and are mutually reinforcing. Simultaneous realization of these rights can only be achieved through a human rights-based approach which stresses the correspondence between rights and obligations (see Box 6), There is an urgent need for policies and strategies that support smallholder farmers in adapting production practices that minimize rainfall-induced risk.

A key adaptation investment is appropriate water storage systems (McCartney and Smakhtin, 2010), including improved soil water storage, soil health and soil retention to groundwater infiltration improvements and supplemental irrigation, particularly during dry spells. These innovations are proven strategies for boosting water security in rainfed agriculture systems, as they increase the resilience of rainfed agriculture to weather anomalies and alleviate soil moisture stress, thus reducing the risk of crop failure, and increasing availability of nutritious foods in local markets (HLPE, 2015).

In addition to crop production, and market impacts (i.e. availability, accessibility, and stability of supply), climate change-related water stress is also affecting the utilization dimension of food security via its adverse impact on level and quality of food intake. For example, Carpena (2019) finds that in rural India dry shocks lead households to consume fewer calories, proteins and fat and that household diets consequently become less balanced. A review of studies linking climate change and undernutrition by Phalkey et al. (2015) concludes that limited evidence suggests a strong linkage between weather variables and childhood stunting. Moreover, FAO, IFAD, UNICEF, WFP and WHO (2018), find a correlation between climate extremes and food insecurity. Finally, periodic droughts that dry up animal watering holes affect availability of animal source foods in various parts of Africa. For example, Koo et al. (2019) estimate that during the 2015/2016 El Niño event in Ethiopia, cattle herds declined by 23 percent in the drought-prone lowlands, where most pastoralists reside. Freshwater capture fisheries, which are of particular importance in large parts of Asia, Africa and Latin America, are also shrinking. The many proposed solutions to freshwater fisheries decline include better integration of freshwater fisheries into irrigation systems (see Case Study 1), or reservoirs.

Case study 1.
Integrated rice-fish production

Throughout Southeast Asia, many irrigation systems are inefficient in their water use. They are unable to supply water effectively during droughts, unable to resist floods, are high emitters of greenhouse gases and major sources of agrochemical water pollution. Consequently, they are considered one of the main causes of degradation of freshwater ecosystems and fisheries (Gregory et al., 2018).

Furthermore, in many cases, they are designed solely for rice production, making it almost impossible to grow alternative, more nutritious crops. Modernizing such systems – for example, by integrating the production of fish and more nutritious (and higher-value) crops and simultaneously improving irrigation efficiency – requires not only technological and physical change (to infrastructure, for instance) and innovative water management practices (such as alternate wetting and drying), but also wide-ranging institutional and governance reforms and behavioural change in farmers. Improving water management and remodelling irrigation schemes in this way is no trivial task, but if done successfully, boosts production, increases opportunities for more nutritious food production and builds adaptive capacity and resilience (McCartney et al., 2019).

McCartney et al. (2019) describe interventions that can support joint crop and fisheries output in large-scale irrigation systems. They include: 1) structural changes within the irrigation command area, such as the incorporation of fish nurseries and refuges, and connectivity for wild fish movement within the scheme; 2) changes to the extended command area, such as changes in the diversion infrastructure to support up- and downstream movement of fish; 3) activities at the catchment levels, such as reduction of trade-offs with other ecosystems services, such as recreation and improvements to water quality; and 4) policy reform at the national level to support strategies and institutions to better manage multiple food and nutrition security, as well as environmental and goals.

In Lao PDR, increasing protein, fat and micronutrient intake is critical for the majority of the 1.1 million people (16 percent of the population) who remain undernourished. To this end the 8th National Social Economic Development Plan (Government of Lao PDR, 2106) identifies aquaculture and reservoir fisheries as important opportunities for diversification of protein sources and the Agriculture Development Strategy (Government of Lao PDR, 2015) incorporates a fish consumption target of 33 kg/person/year by 2025. Against this background the National University of Lao in conjunction with the Living Aquatic Resources Research Centre (Lao PDR) and Charles Sturt University (Australia) have conducted considerable research on approaches to better integrate fish into irrigation systems as a contribution to nutrition sensitive approaches. This includes the design of fish passes and water control gates that enable many species of Mekong fish to by-pass blockages to passage (Baumgartner et al. 2019).

Climate change has also been shown to increase “nutrient leaching” through the combined effects of increases in atmospheric carbon dioxide (CO_2),[7] the CO2 fertilization effect[8] and climate change-related impacts on agricultural productivity and associated changes in food trade. As water security is fundamental to agricultural production, it is also implicated in these projections. A recent study (Beach et al., 2019) finds that growth in the global availability of nutrients will decline by 19.5 percent for protein, 14.4 percent for iron and 14.6 percent for zinc. Thus, increasing concentrations of atmospheric CO2 will slow progress on eliminating nutrient deficiencies, with most impacts on populations that are already nutrient deficient and water insecure.

7 Increased concentrations of CO_2 may affect the nutrient content of some crops.
8 Increased concentrations of CO_2 tend to increase crop yields, other factors held constant.

Additionally, aflatoxin levels are predicted to rise as a result of climate change-induced water stress and post-harvest management and storage in a more variable and hotter and wetter climate (for example, van der Fels-Klerx et al. 2019; Medina et al. 2014). Multiple strategies have been proposed for how to address this challenge, including support to consumers to change their diets, support to producers to change agricultural and post-harvest management practices, and recognition of a price premium for aflatoxin-free foods (Brown 2018).

Finally, climatic shocks are increasing the prevalence and risk of water-related disease (e.g. pathogens such as E.coli and vector-born infections like malaria) (FAO, IFAD, UNICEF, WFP and WHO, 2018). As described in Section 3.1, above, these diseases are a proximal driver of poor nutrition outcomes and improving water management options are vital to reduce their impact (for example Wielgosz et al. 2013).

4.2. Growing competition for water: Increasing demand and inequity

The SDG Indicator 6.4.2[9] assesses efficiency of water use within a country or sub-region by computing total water use across sectors, divided by total renewable freshwater resources (UN Water, 2018). The latest data for this metric indicate that water stress is over 60 percent in Western Asia, Central Asia and Northern Africa. Moreover, 23 countries experience water stress above 70 percent, while 15 countries withdraw more than 100 percent of their renewable freshwater resources (FAO, 2019).

However, just as indicators of national food security are incomplete because they mask variations in sub-national, household and individual level food insecurity (Barret, 2010), indicators of national water availability can obscure heterogeneity at household and individual level. For example, the Democratic Republic of Congo is considered water rich and has more than half of Africa's water reserves (UN Environment, 2011), but in 2011, approximately three-quarters of the 51 million people in the country had no access to safe drinking water. In contexts like this, availability cannot be equated with access, as lack of infrastructure, contamination concerns, high costs, or risks associated with collection pose fundamental blocks to water security at the household and individual level (Box 2).

Box 2.
Every-day water challenges faced by vulnerable populations around the world

- Pollution of accessible water sources from i) chemical contaminants (cities, industry, and agriculture are the main sources), and ii) water borne disease (e.g. vectors, faecal contamination).
- Shrinking water sources from i) competition between water used for irrigation and water used for WASH, ii) drought, and iii) anthropic diversion or destruction of water sources (e.g. for hydropower or filling in wetlands for urban development).
- Physical absence/poor maintenance of water management infrastructure.
- Limited access (especially for women), due to physical collection risks, geographical and distance issues, high financial cost, or taboos related to gender and socio-economic status (Mehta et al. 2019).
- Heavy or exclusive use of wastewater for irrigation, nutrients and organic matter in agriculture (WWAP, 2017; Mateo-Sagasta et al., 2015).[10]

9 Target 6.4: By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity.

10 Anecdotal evidence and case studies suggest that irrigation with untreated wastewater is a long-standing and widespread practice, but its full extent remains unknown (Raschid-Sally and Jayakody, 2008; Ensink et al., 2004). Thebo et al. (2017) estimate the total agricultural land irrigated with diluted wastewater at 35.9 million hectares. Although the full health risks, costs and benefits associated with the practice remain unknown, Srinivasan and Reddy (2009) find that compared to a control village, villages irrigating with wastewater showed higher adult female morbidity. Other authors have found widespread diarrhoeal disease to be a result of consumption of food produced with wastewater (for example, Newell et al., 2010).

The Household Water Insecurity Experiences (HWISE) Scale was designed to expose precisely these disparities. Analogous to the Food Insecurity Experience Scale (FIES, Ballard et al., 2013), the HWISE Scale assesses whether households are challenged in accessing a water supply that is safe, reliable and good quality (Jepson et al., 2017), even in contexts where national level water security is considered adequate (See Box 3). As such, this metric is an important tool for identifying inequities in household water access and how these are related to other socio-economic indicators, especially income and food security. The poorest families often experience low food and water security. It is these households who most frequently endure first-hand experience of the difficult trade-offs described above (see also Box 3).

Box 3.
The Household Water Insecurity Experiences (HWISE) scale

To date, progress towards equitable and sufficient water has been primarily measured by per capita availability or the proportion of the population with access to safely managed drinking water. Like food balance sheets, these metrics are not of sufficiently high resolution to determine which individuals are most acutely experiencing problems with water, or to quantify health impacts of water problems. Experiences are often considered a more accurate indicator of the challenges of resource insecurity. Hence, the short, simply worded 12-item Household Water Insecurity Experiences (HWISE) Scale was developed to provide a universal, comparable measure of water insecurity (Young et al., 2019).

The HWISE Scale items query the frequency of experiences of problems with accessibility, adequacy, reliability, and safety of water in the household over the preceding four weeks. The scale is a validated, universal, simple measure to comprehensively capture complex, household-level relations between people and water in low- and middle-income countries.

The HWISE Scale has similarities with FIES (Ballard et al., 2013), which considers the multiple dimensions of food insecurity, including food access, use and acceptability. Such high-resolution measures have revealed food insecurity's deleterious consequences for physical and mental health (Jones 2017) and cognitive development (Johnson and Markowitz, 2018), among many other outcomes. Indeed, household-level measures of food insecurity have proved, without doubt, that food insecurity is highly prevalent. They have also served as a tool to help mitigate its impact.

Implementation of the HWISE scale at over 30 sites globally has allowed for novel investigations of the determinants of water insecurity and its impacts on agricultural productivity, food insecurity and dietary diversity. Indeed, preliminary HWISE data have shown greater household water insecurity to be significantly associated with greater household food insecurity (Brewis et al.). What's more, water and food insecurity are co-occurring and mutually exacerbating in many contexts, with consequences for well-being that range from increased intimate partner violence to depression (Workman and Ureksoy, 2017; Collins et al. 2019).

Including the HWISE scale and analogous measures of food insecurity in nationally representative surveys can help monitor water-nutrition trends over time and to investigate how they are shaped by macro-level social, economic and political shifts, climatic variability and local shocks, such as extreme weather events. These data can, in turn, be used to select the most efficacious water-related programmes, technologies (such as less water-intensive crops) and policies, as well as to evaluate their impacts and cost-effectiveness.

Case Study 2 describes one of the commonest of these trade-offs, showing how competition between WASH and irrigation water play out in practice, adversely impacting nutrition and water security of poor families.

Case study 2.
Competition between domestic and irrigation water use in Bangladesh's dry season

Sadeque (2000) describes how the advancement of irrigation technologies in Bangladesh has led to increased competition between poorer farmers relying on manually operated tubewells for domestic water uses and irrigators who use motorized pumps drawing larger volumes of water from deeper wells for rice irrigation during the dry season. The innovation - motorized Deep Tubewells (DTWs) - can extract large volumes of groundwater for irrigation, which leads to temporary drawdown of water tables in adjoining areas and lowers the overall level of the aquifer. This technology has contributed to the rapid expansion of dry-season irrigation in the country, particularly for rice, but at the same time has exacerbated a rural drinking water crisis as irrigation wells lower water tables to levels that cannot be reached by manual handpumps that are used to extract water for domestic uses. Added to this is the knowledge, since the 1990s, that shallow groundwater in parts of Bangladesh, contains elevated levels of arsenic (As), while DTWs can generally supply drinking water of acceptable chemical and microbial quality (van Geen et al. 2016).

Jobeda Khatun, a landless widow with two daughters and one son, has a hand tubewell on her home plot, which also serves additional households in the neighbourhood. This pump becomes inoperable during the dry months of February to April, which are also the main irrigation months. At that time she and her daughters (13 and 17 years old) scramble to collect water from the nearest Tara pump (that can extract a limited volume of water from up to 15 meter depth) 500 meters away. Local customs do not allow her and her daughters to seek water from the DTW in the further-away irrigation fields. Moreover, DTWs are typically operated during night hours and as a landless household her household is disadvantaged from getting access to water extracted on farmland (Sadeque 2000).

While DTWs have been more recently deployed to avoid arsenic contamination, this deployment seems to have been dramatically skewed, at least in some areas, toward land holdings with lower levels of initial arsenic contamination and to areas with relatively richer land owners, suggesting elite capture of a public good. Improper deployment of DTWs for drinking water thus resulted in unnecessary additional mortality due to cardio-vascular disease and cancers of the lung, liver, and bladder in adults, as well as diminished intellectual and motor function in children due to continued arsenic exposure of poorer and lower-status households (van Geen et al. 2016).

Proposed solutions for the competition between DTWs and domestic uses of water include: 1) clear government policy strategy and implementation of prioritization of high-quality (non-contaminated) water for drinking purposes; 2) continued monitoring of water quality of DTWs and development of multiple-use systems from appropriate DTWs that supply irrigation and domestic users; 3) Increase transparency and ensure community participation in the development of drinking water systems with a special focus on women and adolescent girls who are responsible for domestic water supply; 4) Support cropping pattern changes in the dry season from rice (water intensive and nutrient poor), to legumes (water efficient and nutrient rich), and fruits and vegetables (water intensive and nutrient rich).

With respect to key drivers of water demand, domestic and industrial water needs are projected to outpace those for irrigation over the next four decades, particularly in developing countries (Ringler et al., 2016).

Changing diets are a third significant driver of water demand with major health and equity impacts. As described in Section 3.6, consumption of ultra-processed foods, over-consumption of animal source foods, and foods and beverages that are high in sugar is increasing world-wide. All of these foods rely on crops with water needs that are higher than traditional diets (Ringler and Zhu, 2015). Moreover, their proliferation (see Section 3.3, Figure 4)

has been driven in part[11] by decades of heavy research and investment in staple cereals, oilseeds, vegetable oil technologies, with consequent underinvestment in coarse grains, fruits, legumes, and vegetables (Pingali, 2015; Popkin, 2011). As a result, nutritious diet options are neither available nor affordable in many contexts, and poorer consumers are often forced to fall back on cheaper, less healthy foods which are i) empirically directly linked to poor health and nutrition outcomes (Global Burden of Disease Study, 2013; GLOPAN, 2016b; HLPE, 2017), and ii) put added pressure on water resources, which are often already over-used.

Again, it is the most vulnerable populations that bear the brunt of this development. In both developed and developing countries, poorer people eat the least healthy diets, have the worst health outcomes, and are most directly exposed to the adverse impacts of water insecurity.

11 Globalization, market liberalization, and vertical integration of key food and commodity industries (e.g. poultry, vegetable oil) are also drivers.

5 Recommendations for accelerated progress on water and nutrition security

Based on the heightened need for action as a result of growing competition for water resources, and further exacerbated by climate change and growing inequities in access, this chapter presents three Recommendations to advance joint progress on SDG 2 and SDG 6. Joint progress, underpinned by a joint approach is imperative also in the context of the indivisibility of human rights, in this case the right to adequate food, the right to water and sanitation and the right to health. When these are respected, protected and fulfilled, equitable access to adequate food and water will be improved (see 5.3, Box 6). All three can be taken up by the work programs of the UN Decade of Action on Nutrition and the UN International Decade for Action on Water for Sustainable Development. These Recommendations also target non-UN actors in these fields, including the private sector, civil society, academia and government.

Recommendation 1: Implement nutrition-sensitive agricultural water management

Implementing nutrition-sensitive agricultural water management means producing food in adequate quantity and quality while also safeguarding water and other natural resources.

In rainfed systems, this requires rainwater harvesting as well as soil conservation practices that involve the most vulnerable segments of society, including those directly involved in such practices, such as mulching, terracing, and tillage to improve soil health. These strategies increase infiltration of rainwater into the soil and improve soil water storage, minimizing evaporation and increasing the likelihood that crops remain healthy and develop to maturity with maximum nutrient content (FAO and SIWI, forthcoming).[12]

Supplemental irrigation,[13] can also help unlock additional yield potential in rainfed systems, particularly during dry spells (FAO, IFAD, UNICEF, WFP and WHO. 2019; Mehta et al. 2019; FAO and SIWI, forthcoming), as it expands production into the dry season - often referred to as the “hunger season” or “lean season” in rainfed-dependent systems. It also can diversify production toward more nutritious crops, such as fruits and vegetables, that risk-averse farmers might otherwise not try to grow. As described in Section 3.6, a major challenge facing today’s food system is low availability and accessibility of fruits and vegetables, leading to decreased intake and subsequent poor nutrition outcomes. Irrigation is a key mechanism to increase production of these crops.

12 That said, since pests and low soil availability can sometimes limit yield more than water availability per se, applications of fertilizers, pest management and other proven agronomic processes must be used to achieve optimal yield.

13 Supplemental irrigation relates to the addition of small amounts of water to essentially rainfed crops during times when rainfall fails to provide sufficient moisture for normal plant growth.

Supplemental irrigation can increase productivity in rainfed production systems, particularly during dry spells, and can directly or indirectly create a reliable source of production of animal feed, thus improving household food security and nutrition.

In addition to improved yield and diversification of production on farm, three additional positive pathways between small-scale, dry-season irrigation and nutrition have been identified (Figure 5), namely increased income, improved WASH, and increased women's empowerment (Passarelli et al., 2018; Domènech, 2015):

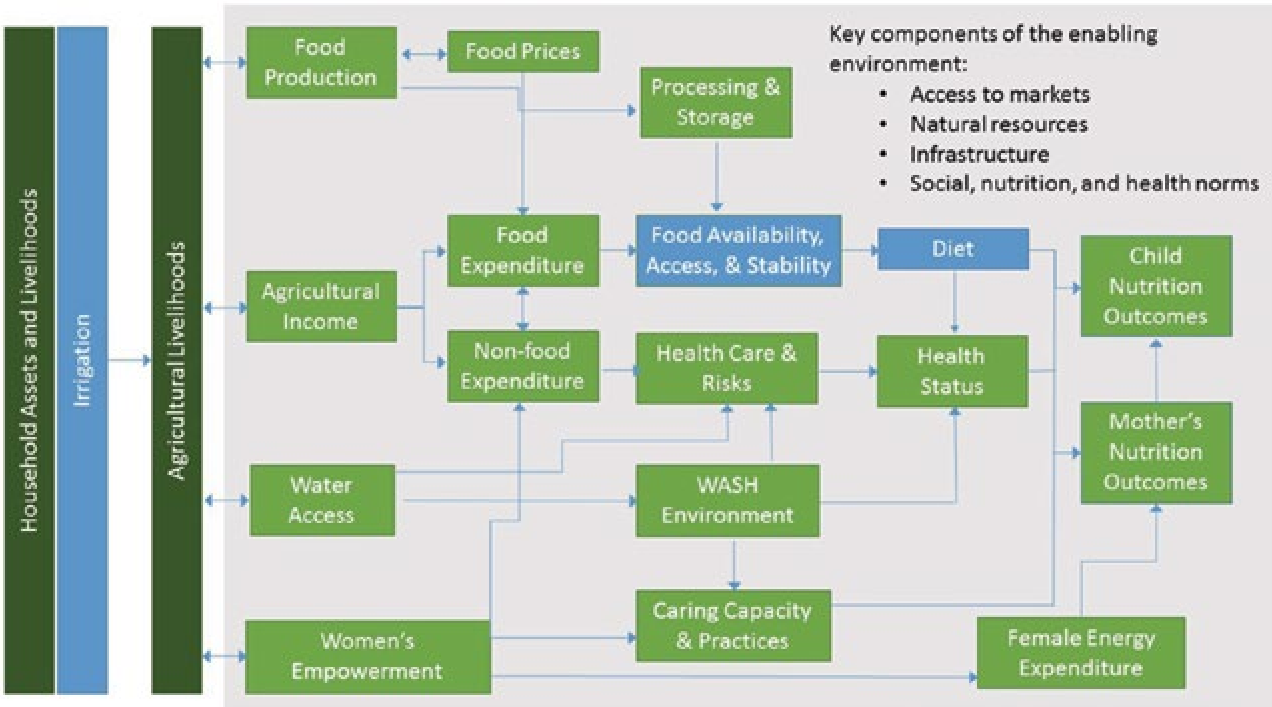
- Increased income: Small-scale, supplemental irrigation can improve incomes through commercialization of increased crop production, through the commercialization of higher-value crops that require more water control, and through the generation of irrigation-related employment (such as irrigation-service providers), particularly in the lean season when employment opportunities in rural areas are scarce (Namara et al., 2011; Burney and Naylor, 2012; Alaofè et al., 2016).

- Improved water access: Small-scale, supplemental irrigation can improve the WASH environment by providing water for multiple uses, but this requires systems that are designed to meet the needs of both agricultural production and domestic uses (van Koppen et al. 2006) and that are non-discriminatory and sensitive regarding the most vulnerable populations.

- Women's empowerment: Women are among the most vulnerable and discriminated groups in societies. Small-scale, supplemental irrigation can also be an entry point for women's empowerment through increased asset ownership. This may occur if irrigation permits women to engage in income-generating activities that they would have otherwise not been able to do, or if they can control resources from increased production on their own plots (Cairncross et al., 2010; Olney et al., 2015; Theis et al., 2018). At a minimum, access to irrigation water of sufficient quality near the homestead can reduce the time spent collecting water for domestic uses, a task still performed by approximately 206 million people (UNICEF and WHO, 2019), primarily women and girls.[14]

14 See also Recommendation 3

Figure 5.
Positive pathways between irrigation and maternal and child nutrition



Source: Passarelli et al. (2018) licensed under CC BY 4.0 (http://creativecommons.org/licenses/by/4.0). Adapted from Herforth and Harris (2014)

It is important to note that increased yield or quality of agricultural production, more income, better access to water, or women's empowerment in isolation will not necessarily translate into improvements in food intake or nutritional outcomes. Each are necessary but not sufficient; that is, if the necessary infrastructure is not available for food storage, or if the accessible water is not clean, then nutrition is unlikely to improve (Gerber et al. 2019).

Box 4.
Guidance on nutrition-sensitive irrigation and water management

The current body of evidence on the linkages between irrigation, water management, water supply and sanitation, and nutrition provides insights into the nutrition-sensitive enhancements that are needed to achieve greater impacts on early child nutrition. Current approaches have been mainly designed with more upstream outcomes in mind, such as improvements in access to and use of water and sanitation services and improvements in the availability of food and income for irrigation investments. In addition to enhancing existing water services, improved coordination with other sectors is needed to help ensure that children receive all the nutrition inputs necessary for better outcomes, not only water-related inputs. Bryan et al. (2019) summarize key entry points to enhance the nutrition sensitivity of irrigation and water-management investments to ensure greater impact. These include:

1. **Incorporate nutritional considerations into the design of projects**
   Understanding the nutritional profile of the beneficiary population, including the prevalence and types of micronutrient deficiency – such as lack of food sources rich in vitamin A or iron, deficiencies in the consumption of certain food groups or lack of dietary diversity – can inform the choice of crops to generate both income and nutritional benefits.
2. **Maintain and improve the natural resource base**
   Conservation and restoration activities, including reforestation programs, wetland restoration and buffer strips to reduce nutrient and sediment runoff from agricultural land into waterways, can impact downstream sedimentation, runoff, fisheries and agricultural productivity.
3. **Equip cooperatives, agricultural extension services and water-user associations for nutrition and dietary considerations**
   Making use of existing water- and agriculture-related platforms to communicate messages on household nutrition could be a cost-effective way of reaching target populations. Topics might include healthy diets, resource planning and food-storage practices to ensure food availability throughout the year, food safety and hygiene.
4. **Leverage community platforms to deliver nutrition messaging**
   Other community-based platforms that target pregnant women and households with young children, such as schools, health centers, and savings groups, could be equipped with information and messaging to promote household nutrition and healthy diets. This messaging could be reinforced through irrigation-related platforms.
5. **Engage women in irrigation interventions**
   Including women in irrigation interventions can influence the types of crop grown, how income from food production is used and how their time is spent, in addition to boosting women's empowerment. Each plays a role in nutrition outcomes in the home.
6. **Promote nutrient-dense crops and incorporate home-gardening components into irrigation projects**
   Promoting nutrient-dense crops could lead to improvements in household nutrition, whereby a portion of production is diverted to household consumption or sold in local markets, benefiting a wider population. Promoting home gardens can encourage the domestic consumption of a more diverse diet.
7. **Design formal multiple-use water systems that are culturally appropriate and safe**
   Water systems that are designed for multiple purposes and that consider health and environmental outcomes may reduce overall time spent collecting water, freeing up time for productive uses and caregiving, increasing the health and nutritional gains of irrigation water.
8. **Mainstream irrigation into community-based platforms for rural service delivery**
   Social protection and livelihoods programs provide a community-based platform for delivery of small-scale infrastructure as well as financial safety nets to a targeted set of households, protecting them from shocks and providing resources to strengthen their resilience.

Source: Bryan et al., 2019.

To strengthen the FSN and water security pathways from irrigation to nutrition, irrigation infrastructure should be co-designed with health and nutrition specialists, as well as market and marketing experts. Furthermore, their deployment should be complemented by nutritional education, potentially through extension services, cooperatives or community health workers.

At the same time, traditional platforms accessed by farmers, such as cooperatives, agricultural extension services and water user associations, as well as health centres and savings groups that target women farmers and households with young children, can all be used to transmit information on nutrition and dietary considerations and how they are linked to irrigation. Depending on context, such messaging needs to go beyond crop farming to also include information on how to improve nutrition through livestock herding and aquaculture (which can also improve through enhanced agricultural water management), as well as information on how these systems fit into wider landscapes.

Recognition of these requirements is growing, along with guidelines for their implementation. At country level, for example, a pilot curriculum developed for Malawi and Tanzania that includes elements of agroecology, nutrition, climate change and social equity has been developed (Bezner et al., 2019); in Uganda, an integrated malaria-farmer education curriculum through Farmer Field Schools was considered (Wielgosz et al., 2013). At global level, there are the FAO Recommendations on Improving Nutrition through Agriculture and Food Systems (FAO, 2015), along with the World Bank Guidance on Nutrition-Sensitive Irrigation and Water Management (Bryan et al., 2019; see Box 4). A good example of actions to advance a joint progress on SDG 2 and SDG target 6.4, is the FAO and IFAD project on "increasing water productivity for sustainable nutrition-sensitive agriculture production and improved food security". Through the project, FAO developed an innovative methodological framework to estimate how the choice of crops, water and soil management and best farm practices can be modified to ensure the production of high nutrient density crops and crop diversification, with specific focus on rainfed production system, which will in turn contribute to the achievement of the SDG 2 and SDG target 6.4. The project will be piloted in six countries (i.e. Rwanda, Mozambique, Egypt, Benin, Niger and Jordan) for a period of 3 years and will start in the first quarter of 2020.

In addition to the challenge of realizing a positive transmission pathway from irrigation to nutrition, there are many potentially adverse impacts posed by irrigation itself, each of which can undermine nutrition gains. First, given the cost of irrigation (and other water management technologies), there are increasing inequities between richer farmers who can afford the technologies and those without access, such as poorer and women farmers (see, for example, Lefore et al., 2019). Second, pollution of water bodies, including contamination of drinking-water sources with agricultural chemicals, and increased incidence of vector-borne diseases that thrive in standing water (Mateo-Sagasta et al. 2018; Kibret et al., 2016; Gerber et al. 2019) are potential side effects of irrigation systems.

Notably, irrigation technologies are increasingly being designed to address these challenges. For example, precision agricultural technologies that apply water where and when it is needed ("just-in-time" technologies), lifting groundwater (rather than collecting water in surface reservoirs) to avoid cross-contamination and standing water, and appropriate integrated pest management to address plant, animal and human diseases can address several of these challenges.

Additionally, for most irrigation structures (ranging from large and permanent, to small-scale and supplemental), multiple-use water systems can be designed that, from the beginning, account for all potential water uses and as such, protect against potentially adverse impacts (e.g. reuse of agricultural drainage water for WASH). These systems can also incorporate environmental water requirements or flows (e-flows) into their blueprints, considering not only the immediate physical availability of water in a given catchment area, but also long-term implications of that water's use in terms of sustained ecosystem services and support of human cultures, economies, livelihoods and well-being, including FSN (see Case Study 3).

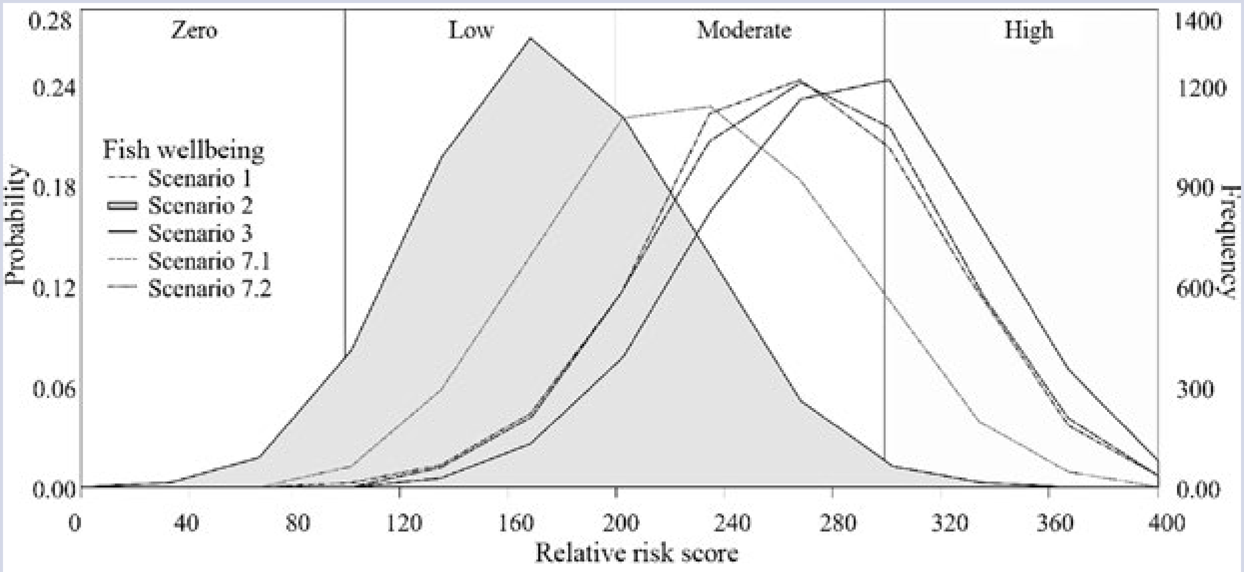
During the design phase, these multi-use systems require donors and recipient organizations to request input not only from irrigation engineers, but also from health and nutrition experts, and extension officers and agronomists, and also need to solicit input from the most vulnerable groups, including farmer groups and groups that are more likely to be frequented by women (van Koppen et al. 2006).

Case study 3.
Environmental flows reduce the risk of fisheries failure

Around the world, countries are assessing the environmental flow requirements of rivers, using models ranging from simple desktop simulations to high-cost two-year studies (Horne et al., 2017; Arthington et al., 2018). One of these, called PROBFLO, is expressly designed to make the connection between alterations in river flow due to upstream use or even climate change, with changes to the ecosystem and provision of ecosystem services and thus, the achievement of a variety of endpoints (for example, fisheries, water for riparian irrigation or domestic water). One such study [reported by O'Brien et al. (2018)], carried out on the Senqu River in Lesotho, contrasted increasingly large dam development scenarios with the maintenance of ecosystem services through the provision of environmental flows, including both the abundance of ecosystem services as well as the use of these ecosystem services by downstream communities.

The following graph shows how scenarios of rising stress as a result of increasing water removal due to a large inter-basin transfer of water, increased risk to fish well-being (and, by implication, fisheries). The natural flow regime (the grey shaded area) had a low risk, while the fisheries under scenarios 3-7.2 were at moderate to high risk of failure (O'Brien et al, 2018). A river flow regime to satisfy environmental requirements was selected from scenarios that minimized the risk to the full range of ecosystem services as well as the natural ecosystem (not shown here). Ultimately, the final decision on what risk to accept, which would determine how much water could be withdrawn for inter-basin transfer and, thus, how much water should be allocated for the environmental flow, was a management/political one based on how much risk of service-failure was deemed acceptable.

Risk to fisheries from water removal out of river systems



Source: O'Brien et al. (2018).
Probability profiles generated during a PROBFLO assessment to describe the relative risk of altered river flows associated with alternative management scenarios considered in the Lesotho case study to the fish wellbeing endpoint. Scenarios included the present-day flow (1), the natural pre-development flow (2 – the grey shaded area) and, in scenarios 3-7.2, increasing levels of flow alteration.

In sum, for this first recommendation on nutrition-sensitive agricultural water management, nutrition and health experts need to join forces with water managers at the farm household level, at the community and irrigation scheme levels and at the government level to strengthen the positive transmission pathways between rainfed and irrigated agriculture, and FSN. Sample actions include:

- Encouraging smallholders who rely primarily on rainfed production to produce more nutrient dense foods through supplemental irrigation (including irrigated fodder for livestock) and adopting soil conservation practices.
- Using irrigation water to improve nutrition outcomes by improving the WASH environment, and by strengthening women's empowerment in agriculture.
- Increasing guidance geared toward irrigation investors, extension personnel who provide advice to rainfed and irrigating farmers, and catchment managers whose task is to conserve watersheds, on water management-nutrition impacts.
- Incorporating joint agricultural water-nutrition management programming into food-for-work and other social protection programs.
- Raising incentives for farmers to produce more nutrient-dense, "water wise" crops via the establishment of procurement programs which provide a guaranteed market.

Recommendation 2:
Ensure the environmental sustainability of diets

As has been described in this report, water resources are being rapidly degraded and food systems play a key role in this degradation. Per Section 3.3, rice, sugarcane, soy, wheat, and maize are among the most commonly grown crops in the world. As such, they consume considerable freshwater resources. They also hold limited macro and micronutrients and are often used in ultra-processed products that are high in saturated fats and sugars.

Animal products from intensive livestock systems also play a pivotal role in this problem, as products from industrial, feed-based systems generally consume and pollute more ground- and surface water resources than animal products from grazing or mixed systems (Mekonnen and Hoekstra, 2012). In addition to environmental concerns, many (though not all, see Box 5) of the health and nutrition trends associated with these foods are negative, as excess consumption – especially when highly processed (e.g. hot dogs, chicken nuggets, and flavoured milk) - has been linked to a number of NCDs as well as overweight and obesity.

Several studies have also implicated ASFs in the growing equity issues surrounding access to both healthy diets and water. Examples include Renault and Wallender (2000), who find that a twenty-five-percent reduction in the consumption of animal products in developed countries could generate twenty-two percent of the additional water needed globally by 2025, and Jalava et al. (2014), who find that if the share of animal products in human diets could be reduced, an additional 1.8 billion people could be fed. However, other studies find smaller changes in overall livestock consumption when over-consumption is reduced in HICs as resulting, lower prices for ASF would spur increased consumption of the same in LMICs. The final result would be improved food and nutrition security in LMICs, but not a large decline in the consumption of ASF (Rosegrant et al. 1999).

Box 5.
Health implications of ASF consumption in LMICS

Demand for ASFs is - unequivocally - too high in developed countries. In LMICs, however, where consumption is rising but remains within the bounds of environmental sustainability, trends are less easily qualified. On one hand, there are young children and other vulnerable populations in these countries whose health and nutrition will benefit considerably from increased ASF consumption. On the other, there is a growing number of people in LMICs for whom overconsumption is a health risk. This caveat, combined with the positive implications of livelihood generation and the negative implications of increased emissions, creates additional complexity for politicians and policymakers working to assess the net environmental and health benefits of livestock in LMICs (ILRI, 2019).

Fish, through sustainable fisheries, may provide a partial solution to this issue. In many developing countries fish are the main source of protein and micro-nutrients and increased fish intake would be beneficial with fewer of the negative impacts of livestock. Especially classes of small, fully mature, macronutrient, micronutrient and vitamin-rich indigenous species of fish, if consumed whole by women and young children are an important avenue to consider (for example, Longley et al., 2014).

Food waste and loss is another key drain on water resources and has also been implicated in climate change. Between production and decay in landfills, food waste represents billions of tons of greenhouse gas emissions per year. In LMICs, the problem is often one of post-harvest losses due to lack of cold chain technology, sub-par warehousing and long transport times to markets (FAO 2011b). Overeating is considered by some a form of food waste that not only affects the natural resource base but also human health.

In response to these risks, a wide variety of food system reform studies, tools, and initiatives have been launched. One of the most recent and seminal – the EAT-Lancet Commission (Willett et al., 2019) - defines an operating space for food production designated as "safe" across both environmental and health dimensions. The former sets targets for a variety of environmental concerns, including nitrogen and phosphorus emissions, greenhouse gases, land and water use and biodiversity loss. The Commission proposes that food production activities operate within boundaries set by these targets, to sustain both food and environmental security for the growing global population. Five transformative strategies are presented: (1) seek international and national commitment to a shift towards healthy diets; (2) reorient agricultural priorities from producing high quantities of food to producing healthy food; (3) sustainably intensify food production to increase high-quality output; (4) ensure strong and coordinated governance of (agricultural) land and oceans, and (5) at least halve food losses and waste, in line with the SDGs.

The SDGs are an obvious starting point to act on these goals. In addition to SDGs 2 and 6 (which focus, respectively, on FSN/ sustainable agriculture, and increasing water efficiency/access to WASH), SDG 12 on responsible consumption and production addresses both food waste (Target 3) and preventing contamination of water and other natural resources with toxic waste (Target 4).

National food-based dietary guidelines (FBDGs) that include environmental considerations are another important step in ensuring sustainable diets. Also, the Right to Food Guidelines call for States to develop policies in line with a HRBA including nutrition, education and access to natural resources and sustainability.[15]

15 GUIDELINE 8E. **Sustainability. 8.13** States should consider specific national policies, legal instruments and supporting mechanisms to protect ecological sustainability and the carrying capacity of ecosystems to ensure the possibility for increased, sustainable food production for present and future generations, prevent water pollution, protect the fertility of the soil, and promote the sustainable management of fisheries and forestry (FAO, 2005).

Several countries, notably Brazil and Sweden, have already developed dietary guidelines that take sustainability, including water use, into account. Such national guidelines provide the anchor or "steer" for countries' nutrition and food security policies and programmes. When they include water and other natural resource considerations, they can influence the entire direction of a country's food system, focusing attention on the need for sustainability all the way from pre-farm gate production choices to consumer behaviour regarding diet and food waste.

More work is urgently needed to understand the impact of current dietary trends on environmental resources, and vice-versa; not only in terms of documenting harm done under the current status-quo, but also with respect to practical recommendations for regional and national stakeholders on policy reform and investments that counter-act the heavy tolls that are being exacted by current diet trends. Sample actions include:

- Encouraging countries and regional associations to leverage their own FBDGs, SDGs 2,6 and 12, and food system assessments (e.g. the EAT-Lancet Commission) for concrete collaborations between agriculture, conservation, and health platforms.
- Increasing investment in research that attempts to measure the impact of diets on natural resources. To date, such studies are hamstrung by consistent lack of information on which foods and drinks constitute a country's "national diet". Data on water use in food preparation and processing are also limited.

Recommendation 3:
Address social inequities in water-nutrition linkages

When considering overall inequalities, including gender, in access to adequate food and water, it is imperative to look at the challenges with a human rights lens. The UN Committee on Cultural, Social and Economic Rights has elaborated on the right to adequate food in its General Comment 12, art. 11 of the 1966 International Covenants on Economic Social and Cultural Rights and these establish clear States Parties Obligations.

While water has not been explicitly recognized as a self-standing human right in international treaties, international human rights law entails specific obligations related to access to safe drinking water. For instance, the United Nations Committee on Economic, Social and Cultural Rights adopted its general comment No. 15 on the right to water in 2002, and defined it as the right of everyone "to sufficient, safe, acceptable, physically accessible and affordable water for personal and domestic uses." The Committee underlined that the right to water was part of the right to an adequate standard of living, as were the rights to adequate food, housing and clothing. The Committee also stressed that the right to water was inextricably linked to the rights to health, adequate housing and food.

Box 6 explains why reducing social inequities in food and water access should be considered integral to coordinated water-FSN policy and programming.

Box 6.
Progressive Realization of the Human Rights to Food and Water

It is critical that stronger, more coordinated action by both the Nutrition and Water Decades prioritize human rights principles including equality explicitly, as these two Decades and the SDGs they support[16] are predicated on the human rights to adequate food, drinking water and sanitation (UN General Assembly, 2010; UNSCN 2010).[17]

All human rights are indivisible, interdependent and interrelated. There is, however, a special connection between the right to food and the right to water. This means that all individuals are born with them, entitled to each, with no hierarchy between rights. Human rights are also mutually reinforcing, that is, fulfilment of one is likely to strengthen fulfilment of others, while violation of one is likely to impede fulfilment of others. For example, when the poor are obliged to choose between water for drinking and sanitation, or for growing food, the rights are not in conflict, rather, they are both being violated simultaneously. The State obligation to protect both is not fulfilled when people are forced to choose. As such, the progressive realization of food and water rights should not be seen as competing, but as complementary and mutually reinforcing. This can only be achieved through a human rights-based approach which stresses the correspondence between rights and obligations, providing a framework for Member States and other organizations that aims to ensure that respect for human rights are integrated into development plans at all levels, and that human rights principles are guiding their actions (Winkler 2010).

A key aspect of this Recommendation is adjusting for gender as in many contexts, men's and women's experiences around water are very different. While some of these differences are physiological, the most harmful are imposed by society. For example, women are usually responsible for household water acquisition (UNICEF and WHO 2019). As described in Section 4.2 and Box 2, this can be physically taxing, time-intensive, and sometimes dangerous. And while data are generally not collected on intra-household access to clean and sufficient water, disparities in access and utilization are likely, given that major inequities in intra-household food allocation is widely documented (men's diets are typically qualitatively and quantitatively superior to that of women and children's (FAO, IFAD, UNICEF, WFP and WHO. 2019)). At community-level, women may be excluded from water-use associations, even when these associations have established quotas to increase female participation. Women who are widows or otherwise separated from mainstream society may face additional restrictions on access to water.

The fact that i) women are responsible for many water-intensive chores – cooking, cleaning, and bathing children, and ii) women's hydration and hygiene requirements vary depending upon a wide variety of factors [e.g. workload, lactation status, menstrual status, and climate (Jéquier and Constant 2010)], adds further complexity to understanding the gender dynamics of water use.

Because women are usually the primary caretakers for infants and children, their access to water also plays a critical role in perinatal, infant and young children's, and adolescent's nutrition outcomes. A woman's ability to breastfeed can be jeopardized by low hydration status, and the time she has available to prepare complementary foods can be limited by long journeys or queues for water. Purchasing power for food is reduced by these time constraints, as they can prevent wage or agricultural work. The same is true if the financial costs of water

16 SDG 2 (End hunger, achieve food security and improved nutrition and promote sustainable agriculture), and SDG 6 (Ensure availability and sustainable management of water and sanitation for all).

17 However, the use of water for food production or other productive activities is not (yet) considered a human right (see, for example, Van Koppen et al., 2017; Mehta et al. 2019).

are high, as women may need to reduce expenditures on foods for children and indeed the entire family. For rural households, the quantity and quality of household dietary intake, is also directly linked to water used in agricultural production, particularly in the dry or lean season. As an example, the amount of food available may be limited if there is no water to prepare it; for example, there may be flour for porridge, but no potable water to cook it. Again, the entire family is affected, but with especially dire consequences for small children and adolescents, whose nutritional needs are greater than adults. Case Study 4 provides an illustration from Western Kenya of some of these hard choices, while Figure 6 shows how water challenges affect the entire trajectory of malnutrition causes, from basic, to underlying, to immediate.

Case study 4.
Water and food insecurity in the first 1 000 days

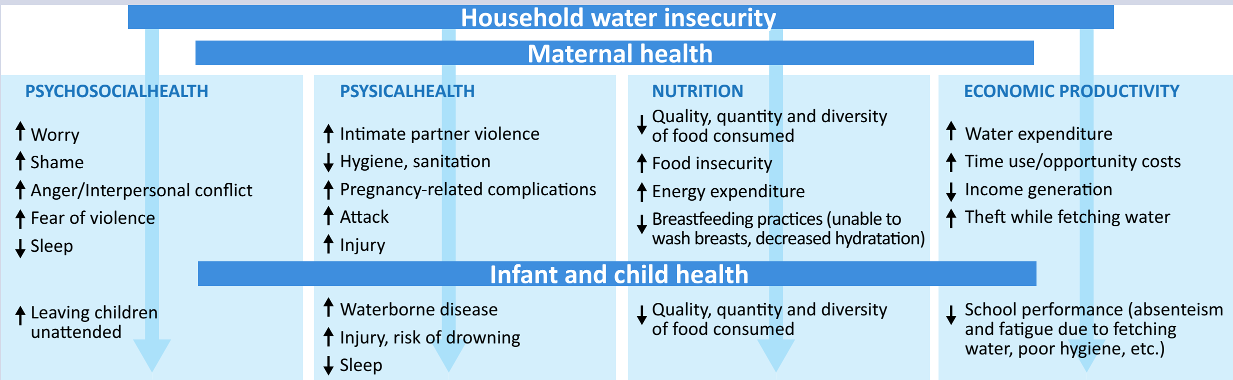
As part of a study quantifying the impact of food insecurity on nutrition, Collins et al. (2019), asked mothers in Western Kenya to photograph what determined how they fed their infants. As a result of the dozens of photos of water that were taken, the study reoriented to water insecurity, employing a variety of ethnographic techniques to unpack the interactions between water stress (too little, too much, poor quality), and women's and children's lives.

Photo: Anonymous, with permission.

"This is the water we use for cooking sometimes... it comes from the prison called Kodiaga. So the prison people let the sewage drain into it … but we still have to use it for cooking. So you get torn in between buying water and buying food. In a way this makes the baby suffer because the money that ought to be used in buying her food ends up buying water. On the other hand, when the food is bought that means that there is no water for cooking."
(quote from Kenyan respondent, Sera Young, personal communication)

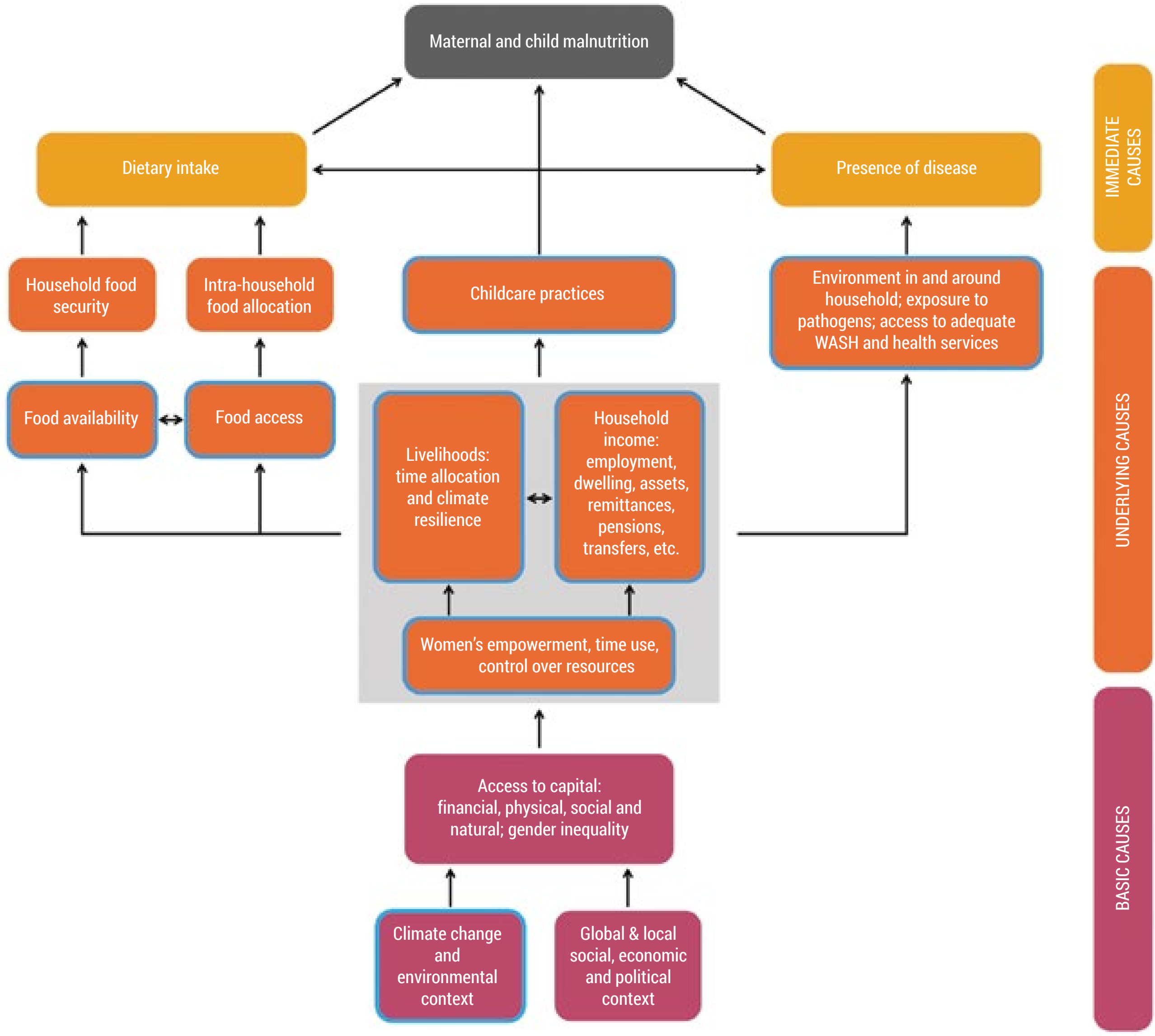
According to women in the study, the perceived consequences of water insecurity for nutrition included decreases in the quality and quantity of foods, e.g. switching to less nutrient-dense foods that were quicker to cook, for example, porridge rather than beans. Food insecurity increased, as did energy expenditure when nearby water sources were unavailable. Breastfeeding also declined for a variety of reasons. The range of impacts went beyond nutrition to include consequences for psychosocial health, like worry and shame, physical health, such as intimate partner violence, and a range of impacts on economic productivity (Collins et al., 2019).

Four Pathways by Water Insecurity was Perceived to be Harmful for Women and their Children in Western Kenya



Source: Adapted from Collins et al. 2019.

Figure 6.
UNICEF conceptual framework for maternal and child malnutrition, modified to highlight linkages to water (in blue)



Source: Adapted from UNICEF (1990).

Gender-based inequities are never acceptable; however, they are particularly egregious in contexts where poverty and hardship are endemic in the general population. This is certainly the case in fragile states. By 2030, 60 percent of the world's poor will live in these countries, where extreme poverty is increasingly concentrated and where the human rights to food and water are tenuous (CGDEV, 2019). Strengthening positive transmission pathways between water and FSN is extremely important in fragile states, due to failures in service provision, protection from water-related disasters, and preservation of surface, ground and transboundary water resources, all of which are associated with worse nutrition outcomes (see Case Study 5).

Humanitarian relief is often needed in fragile states, and humanitarian settings constitute another high-priority area for strengthening positive water-FSN pathways. In these contexts, the population is in constant flux, water infrastructure is often weak or non-existent, and WASH services are informal and unreliable. Moreover, people affected by humanitarian crises are generally at high risk of illness and death from disease. Inadequate access to WASH infrastructure, as well as poor and crowded living conditions, exacerbate this risk, increasing susceptibility to diarrheal and infectious diseases transmitted by the faecal–oral route, as well as by vectors associated with poor sanitation, waste management and drainage.

Case study 5.
Fragility, water and nutrition in Yemen

Efforts to preserve the Republic of Yemen's water resources have been piecemeal and hindered by strong economic interests, political sensitivities, and weak state authority (Hales 2010). As in other fragile contexts where elites have used their power to capture mineral resources and rents, large land-owners and political elites in the Republic of Yemen have captured scarce water resources and suitable agricultural land to invest in cash crops, most notably qat (Ward, 2014). Qat is a mild stimulant consumed by an estimated one in three Yemen is5 that has no nutritional value and whose cultivation consumes more than half of the country's water resources (Lichtenthaeler, 2010). In a country where about 50 percent of children under the age of five are stunted and 40 percent are underweight (World Bank, 2015), limiting qat cultivation and reforming agricultural water use are a priority for food security, poverty reduction, and for preserving adequate, sustainable water resources (World Bank, 2007b). Yet attempts to curtail further expansion of qat cultivation and regulate water use in agriculture have been met with resistance due to strong vested interests (Lichtenthaeler, 2010). This failure to preserve water resources is a critical element in perpetuating water insecurity, contributing to malnutrition and gender inequality and triggering conflict in the Republic of Yemen.

Once lost, regaining control over water resources and shifting towards more sustainable management can be difficult. Factors that have led to success in other countries include good knowledge of the resource, a clear set of rules, user empowerment and regulation and a partnership approach between users and government. In Jordon, the government assigned water rights and quotas based on groundwater studies, used awareness raising to educate the population on the importance of sustainable management, and introduced incentives to farmers and communities that encouraged cooperation and more sustainable use of the resource. Strong governance, political commitment to enforcement and local accountability and engagement were critical factors in the success of this approach (Tiwari et al., 2017).

Source: Sadoff et al. (2017).

Addressing gender inequities is also critical in humanitarian settings. Although WASH is crucial to survival in the first phase of many emergencies and for resilience in succeeding phases, women in refugee camps and other humanitarian contexts are at particular risk of infection, as even if toilets, showers, and other services do exist, they may be unable to access them safely.

In sum, for this third Recommendation on addressing inequities and protecting, promoting and realizing the human rights to food, health and water, it will be important to include demographics that are typically excluded from preferential access to WASH or irrigation services. These social groups need to be proactively included in the development of such services, including incorporating their needs into water infrastructure design. Sample actions include:

- Ensuring that investments in all community infrastructure includes sustainable access to water services into the original design.
- Supporting the multiple water needs of women.
- Ensuring increased equity and inclusivity in water user groups.
- Provision of water to lower-income neighbourhoods in peri-urban settings.
- Requiring irrigation system managers to use satisfaction with water delivery of farmers at the end of canal systems as the yardstick of performance, rather than the demands of more powerful farmers.
- Using irrigation water to improve nutrition outcomes by improving the WASH environment, and by strengthening women's empowerment.
- Ensuring that agricultural support, including irrigation, supplemental irrigation or support to rainfed agriculture, takes into account needs of small-scale farmers.

6 Final considerations

The UN 2030 Agenda for Sustainable Development is grounded in human rights and provides the most formal recognition to date of the interwoven water, food security and nutrition challenges that must be overcome to realize the human rights to adequate food, health and water. But as this report has highlighted, water and nutrition communities could do much more to accelerate impact of both Decades – including achieving SDG 2 and SDG 6 – by strengthening collaboration and joint actions. To date, neither work program has adequately explored normative linkages and joint interventions (UN Decade of Action on Nutrition Secretariat, 2019; UN, 2017). As a result, both initiatives are missing a critical opportunity to identify synergies, reduce trade-offs between the two priorities, and bring countries closer to meeting both sets of targets (as well as many other SDGs).

The Recommendations above aim to inspire action on better leveraging this opportunity. Each Recommendation was designed with both communities in mind, and each includes a wide range of policy investment, research, and programming options. In most cases the "sample actions" provided at the end of each recommendation imply joint action. It is hoped that these and similar ideas will provide a springboard for systematic collaboration across a range of areas related to the water-nutrition nexus.

For example:

For the nutrition community, providing advice on water infrastructure development, such as dams, irrigation systems or water supply systems. These structures and systems inevitably impact WASH, agriculture, the food system, and industries in ways that have major impact on FSN. With nutrition involved in their initial design, the likelihood that transmission pathways will be positive is maximized. For the water community, providing insights to FSN stakeholders on how water can be conserved along food value chains and through more sustainable diets, can dramatically reduce water degradation and as such, put SDG 6 back on track.

Additionally, both communities need to do more to monitor the impacts of their strategies on the other sector, for example by measuring the impact of current diets on water resources, and tracking nutrition outcomes of investments in agricultural water management. Collection of data beyond indicators of interest to only the water or FSN communities will be essential to cross-sectoral progress, and to realizing the human rights to water and food.

The analysis and recommendations in this report are geared not only toward United Nations actors, but also to stakeholders with access to the many other entry points that exist to accelerate progress. Some collaboration already exists between the water and nutrition communities, particularly on WASH, including at the international level between UNICEF and WHO. There is also a considerable body of evidence that assesses the nutrition and health impacts of WASH interventions.

This progress is currently influencing how interventions are developed and has led to the monitoring of certain nutrition impacts under selected WASH interventions. Expanding this type of collaboration and evidence generation to other water-nutrition sub-sectors is imperative for reducing trade-offs, and for strengthening momentum.

The partners and stakeholders gathered under the UN Decades for Water and Nutrition are invited to take the results of this discussion paper forward in their deliberations to advance joint progress on SDG 2 and SDG 6.

WATER
ACTION DECADE
2018-2028

UNITED NATIONS DECADE OF
ACTION ON NUTRITION
2016-2025

Annex A

Cross-sectoral elements in the work programs of the United Nations Decade of Action on Nutrition and the United Nations Water Action Decade

Table A1.

Work program elements of the UN Decade of Action on Nutrition that relate to water and suggestions for improvement

Work program elements of UN Decade of Action on Nutrition that consider water	Suggestions for improvement
Action Area 1: Sustainable, resilient food systems for healthy diets	
Causes of malnutrition listed include "poor sanitation and hygiene, food-borne infections and parasitic infestations, ingestion of harmful contaminants due to unsafe food production or preparation practices, and a lack of access to education, quality health systems and safe drinking-water", also "climate change" (p. 1).	The multiple roles of water in affecting malnutrition could be listed, beyond WASH and climate change, i.e. competition for water, unavailability of sufficient or clean water, among others, because of food production, etc.
A call for innovations to secure "sustainable, healthy diets for all" and to "reduce food and nutrient losses and waste" (p. 5).	This area could consider how dietary recommendations could be adjusted to increase sustainability of natural resources (Recommendation 2)
Call for sustainable consumption (p. 5).	An explanation of what sustainability means or why it is needed could be added.
Call for to address food safety issues, which is linked with contaminated water and poor sanitation (p. 5).	The contribution of food value chains to contamination could be mentioned or that implementation of this action also supports SDG6.
	The role of nutrition-sensitive agricultural programs is missing, including nutrition-sensitive rainfed and irrigated agriculture (Recommendation 1).
Action Area 5: Safe and supportive environments for nutrition at all ages	
"In line with the global call for action on sanitation, efforts should focus on improving hygiene, changing social norms, better management of human waste and wastewater, and completely eliminating the practice of open defecation by 2025" (p. 7)	The role of healthy watersheds and overall water management could be added here.
Call for sustainable consumption (p5).	An explanation of what sustainability means or why it is needed could be added.
Call for to address food safety issues, which is linked with contaminated water and poor sanitation.	The contribution of food value chains to contamination could be mentioned or that implementation of this action also supports SDG6.
	The document misses an action area on the special role of women and the need to consider various social structures for achieving nutrition outcomes. (Recommendation 3).

Source: www.un.org/nutrition/sites/www.un.org.nutrition/files/general/pdf/work_programme_nutrition_decade.pdf.

Table A2.

Work program elements of the UN Decade for Action "Water for Sustainable Development" that relate to nutrition and suggestions for improvement

Work program elements of UN Decade for Action "Water for Sustainable Development"	Suggestions for improvement
Work Stream 1 Facilitating access to knowledge and the exchange of good practices	Suggest to note the importance of progress on SDG 6 for key other SDGs, such as SDG 2, including nutrition; suggest to increase focus on action in the agriculture sector, as the major water user; gender mainstreaming and equality are mentioned but without a specific outcome. This could be made clearer.
Work Stream 2 Improving knowledge generation and dissemination, including new information relevant to water-related SDGs	
Work Stream 3 Pursuing advocacy, networking and promoting partnerships and action	
Work Stream 4 Strengthening communication actions for implementation of the water-related Goals	

Source: https://wateractiondecade.org/wp-content/uploads/2018/03/UN-SG-Action-Plan_Water-Action-Decade-web.pdf.

Annex B

The water and nutrition targets under SDG2, (zero hunger) and SDG6 (water)

Table B1.

SDG 2 targets on food security and nutrition

SDG 2 targets

2.1	By 2030, end hunger and ensure access by all people, in particular the poor and people in vulnerable situations, including infants, to safe, nutritious and sufficient food all year round.
2.2	By 2030, end all forms of malnutrition, including achieving, by 2025, the internationally agreed targets on stunting and wasting in children under 5 years of age, and address the nutritional needs of adolescent girls, pregnant and lactating women and older persons.
2.3	By 2030, double the agricultural productivity and the incomes of small-scale food producers, in particular women, indigenous peoples, family farmers, pastoralists and fishers, including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets and opportunities for value addition and non-farm employment.
2.4	By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extrefme weather, drought, flooding and other disasters and that progressively improve land and soil quality.
2.5	By 2020, maintain genetic diversity of seeds, cultivated plants, farmed and domesticated animals and their related wild species, including through soundly managed and diversified seed and plant banks at the national, regional and international levels, and promote access to and fair and equitable sharing of benefits arising from the utilization of genetic resources and associated traditional knowledge, as internationally agreed.

Implementing mechanisms

2.A	Increase investment, including through enhanced international cooperation, in rural infrastructure, agricultural research and extension services, technology development and plant and livestock gene banks to enhance agricultural productive capacity in developing countries, in particular least developed countries.
2.B	Correct and prevent trade restrictions and distortions in world agricultural markets, including through the parallel elimination of all forms of agricultural export subsidies and all export measures with equivalent effect, in accordance with the mandate of the Doha Development Round.
2.C	Adopt measures to ensure the proper functioning of food commodity markets and their derivatives and facilitate timely access to market information, including on food reserves, to help limit extreme food price volatility.

Source: https://www.un.org/sustainabledevelopment/hunger/.

Table B2.
SDG 6 targets on water and sanitation

SDG 6 targets	
6.1	By 2030, achieve universal and equitable access to safe and affordable drinking water for all.
6.2	By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations.
6.3	By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally.
6.4	By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity.
6.5	By 2030, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate.
6.6	By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes.
Implementing mechanisms	
6.A	By 2030, expand international cooperation and capacity-building support to developing countries in water- and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies.
6.B	Support and strengthen the participation of local communities in improving water and sanitation management.

Source: https://sustainabledevelopment.un.org/sdg6.

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Acronyms

ASF	Animal source foods
CGIAR	A global agricultural innovation network (formerly the Consultative Group on International Agricultural Research)
DTW	Deep tubewell
ECOSOC	United Nations Economic and Social Council
ENSO	El Niño/Southern Oscillation
FAO	Food and Agricultural Organization of the United Nations
FBDG	Food-Based Dietary Guidelines
FIES	Food Insecurity Experience Scale
FSN	Food security and nutrition
HLPE	High-Level Panel of Experts on Food Security and Nutrition
HRBA	Human Rights Based Approach
IFAD	International Fund for Agricultural Development
IFPRI	International Food Policy Research Institute
IWMI	International Water Management Institute
LMICs	Low and middle-income countries
NCDs	Non-communicable diseases
SDG	Sustainable Development Goal
SIWI	Stockholm International Water Institute
UN	United Nations
UNICEF	United Nations' Children's Fund
UNSCN	United Nations System Standing Committee on Nutrition
WASH	Water, Sanitation and Hygiene
WFP	World Food Programme
WHO	World Health Organization

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Discussion Paper

UNSCN vision

A world free from hunger and all forms of malnutrition is attainable in this generation

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